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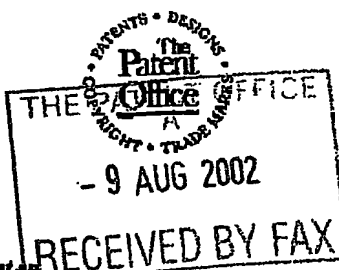
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P01/7700 0.00-0218426.5

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1. Your reference

GBP0270

0218426.5

2. Patent application number

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03 AUG 2002

3. Full name, address and postcode of the or of each applicant (underline all surnames)

Dyson Limited  
Tetbury Hill  
Malmesbury  
Wiltshire  
SN16 0RP

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

UK

806301001

4. Title of the invention

Surface Treating Appliance

5. Name of your agent (if you have one)

Gillian R Smith

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Dyson Limited  
Intellectual Property Department  
Tetbury Hill  
Malmesbury  
Wiltshire  
SN16 0RP  
UK

Patents ADP number (if you know it)

8268294001

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Country

Priority application number  
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Number of earlier application

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a) any applicant named in part 3 is not an inventor, or

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11.

I/We request the grant of a patent on the basis of this application.

Signature



Date

Gillian R Smith

9th August 2002

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DUPLICATE

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Surface Treating Appliance

This invention relates to a surface treating appliance, such as a vacuum cleaner.

5 Surface treating appliances such as vacuum cleaners and floor polishers are well known. The majority of vacuum cleaners are either of the 'upright' type or of the 'cylinder' type, called canister or barrel cleaners in some countries. An example of an upright vacuum cleaner manufactured by Dyson Limited under the name DC04 ("DC04" is a trade mark of Dyson Limited) is shown in Figure 1. The vacuum cleaner comprises a main body  
10 102 which houses the main components of the vacuum cleaner. A lower part 106 of the main body houses a motor and fan for drawing dirty air into the machine and the main body also houses some form of separating apparatus 104 for separating dirt, dust and other debris from a dirty airflow drawn in by the fan. The main body 102 also houses filters for trapping fine particles in the cleaned airflow. A cleaner head 108 is rotatably  
15 mounted, about points A, to the lower end of the main body 102. The axis about which the cleaner head rotates is horizontally directed. A supporting wheel 107 is mounted on each side of the lower part 106 of the main body, in a fixed relationship to the main body 102. In use, a user reclines the main body 102 of the vacuum cleaner and then pushes and pulls a handle 116 which is fixed to the main body of the cleaner. The  
20 vacuum cleaner rolls along the floor surface on the supporting wheels 107.

A dirty-air inlet 112 is located on the underside of the cleaner head 108. Dirty air is drawn into the dust separating apparatus 104 via the dirty-air inlet 112 by means of the motor-driven fan. It is conducted to the dust separating apparatus 104 by a first air flow  
25 duct. When the dirt and dust entrained within the air has been separated from the airflow in the separating apparatus 104, air is conducted to the clean air outlet by a second air flow duct, and via one or more filters, and expelled into the atmosphere.

Conventional upright vacuum cleaners have a disadvantage in that they can be difficult  
30 to manoeuvre about an area in which they are used. They can be pushed and pulled

easily enough, but pointing the cleaner in a new direction is more difficult. The cleaner can be pointed in a new direction by applying a sideways directed force to the handle, either from standstill or while moving the cleaner forwards or backwards. This causes the cleaner head to be dragged across the floor surface so that it points in a new direction. The only articulation between the main body 102 and the cleaner head 108 is about horizontally directed axis A, which remains parallel with the floor surface. In some upright vacuum cleaners the supporting wheels 107 are mounted on the cleaner head rather than the main body. However, the main body is rotatably mounted to the cleaner head about a horizontally directed axis, as just described.

10

Attempts have been made to increase the manoeuvrability of upright vacuum cleaners. Some examples of upright vacuum cleaners with improved manoeuvrability are shown in US 5,323,510 and US 5,584,095. In both of these documents, the vacuum cleaners have a base which includes a motor housing and a pair of wheels, and the connection between the base and the main body incorporates a universal joint which permits rotational movement of the main body with respect to the base about an axis which is oriented perpendicular to the rotational axis of the wheels and inclined with respect to the horizontal.

20 A further, less common, type of vacuum cleaner is a 'stick vac', which is so-called because it has a very slender stick-like main body. An example is shown in EP 1,136,029. Often, there is only a cleaner head at the base of the machine, with all other components of the machine being incorporated in the main body. While stick vacs are lighter weight and can be easier to manoeuvre than traditional upright cleaners, they generally have a small dust separator, a lower power motor and smaller filters, if any filters at all, and thus their improved manoeuvrability comes with the drawback of a lower specification.

30 The present invention seeks to provide a surface treating appliance with improved manoeuvrability.

A first aspect of the present invention provides a surface treating appliance in accordance with claim 1.

- 5 Positioning a means for acting on the airflow within the support assembly makes efficient use of the space within the support assembly. It can also increase the stability of the appliance.

- The means for acting on the airflow can be a suction generating means, such as a motor  
10 driven impeller, a filter or some form of separating apparatus.

Preferably the features of providing support for the rotatable support assembly and of ducting air into and/or out of the assembly are combined by providing a support which has a hollow interior channel.

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A second aspect of the present invention provides a surface treating appliance in accordance with claim 23.

- Positioning the motor within the support assembly makes efficient use of the space  
20 within the support assembly and keeps the centre of mass of the overall appliance close to the floor surface.

- Preferably the motor is housed within the support assembly such that the centre of mass of the motor is aligned with the centre of the support assembly as this further aids  
25 manoeuvrability.

A third aspect of the present invention provides a surface treating appliance in accordance with claim 44.

Providing a substantially continuous support surface in the direction perpendicular to the longitudinal axis of the main body improves manoeuvrability and ensures a smooth transition between the forward running and turning positions.

5 Preferably the support surface extends for a distance which is between 50% and the full width of the main body. This allows the central portion of the assembly to have a flat surface, which aids forward running handling, and the end portions to have a reasonably gentle taper, which aids handling during turning.

10 A fourth aspect of the present invention provides a surface treating appliance in accordance with claim 62.

A fifth aspect of the present invention provides a surface treating appliance in accordance with claim 64.

15

Providing a linkage which allows the main body to be rotated or twisted about its longitudinal axis, in the manner of a corkscrew, greatly aids manoeuvrability and usability of the machine.

20 The term "surface treating appliance" is intended to have a broad meaning, and includes a wide range of machines having a main body and a head for travelling over a surface to clean or treat the surface in some manner. It includes, inter alia, machines which only apply suction to the surface, such as vacuum cleaners (dry, wet and wet/dry), so as to draw material from the surface, as well as machines which apply material to the surface,  
25 such as polishing/waxing machines, pressure washing machines and shampooing machines.

Embodiments of the invention will now be described with reference to the drawings, in which:

## 5

Figures 1 and 2 show a known type of vacuum cleaner;

Figure 3 shows a vacuum cleaner in accordance with an embodiment of the invention,

5 Figures 4 and 5 show the vacuum cleaner of Figure 3 in use;

Figures 6 and 7 show the connection between the cleaner head and main body of the vacuum cleaner of Figures 3 to 5;

10 Figures 8 – 10 show the roller assembly of the vacuum cleaner;

Figures 11 and 12 show the roller assembly in use;

15 Figure 13 shows a cross-sectional view through the roller assembly of the vacuum cleaner;

Figures 14 – 16 show ways of housing a filter within the roller assembly;

20 Figure 17 shows an alternative way of housing a motor and filter within the roller assembly;

Figures 18 – 21 show alternative shapes of roller assembly;

25 Figures 22 - 24 show a roller assembly with two rotating members;

Figure 25 shows an alternative roller assembly with two rotating members;

30 Figure 26 shows an alternative roller assembly with a larger number of rotating members;



Figures 27 and 28 show alternative ways of connecting the main body to the cleaner head.

- 5     Figures 3 - 13 show a first embodiment of a vacuum cleaner 200 with a main body 210, a roller assembly 220 and a cleaner head 230.

The cleaner head 230, as in a conventional upright vacuum cleaner, serves to treat the floor surface. In this embodiment, it comprises a housing with a chamber for supporting  
10     a brush bar 232 (Figure 6). The lower, floor-facing side of chamber has an air inlet slot 233 and the brush bar 232 is rotatably mounted in the chamber such that bristles on the brush bar 232 can protrude through the inlet slot 233 and can agitate the floor surface over which the cleaner head 230 passes. The brush bar 232 is rotatably driven by a  
15     dedicated motor 242 positioned on the cleaner head 230. A drive belt connects the motor 242 to the brush bar 232. This avoids the need to provide a driving connection between the suction fan and the brush bar. However, it will be appreciated that the brush bar can be driven in other ways, such as by a turbine which is driven by incoming or exhaust airflow, or by a coupling to the motor which is also used to drive the suction  
20     fan. The coupling between the motor and brush bar can alternatively be via a geared coupling. In alternative embodiments the brush bar can be removed entirely so that the machine relies entirely on suction or by some other form of agitation of the surface. For other types of surface treating machines, the cleaner head 230 can include appropriate means for treating the floor surface, such as a polishing pad, a liquid or wax dispensing nozzle etc. The lower face of the cleaner head 230 can include small rollers to ease  
25     movement across a surface.

The cleaner head 230 is connected to the main body 210 of the vacuum cleaner in such a manner that the cleaner head 230 remains in contact with a floor surface as the main body is manoeuvred through a wide range of operating positions, e.g. when moved from  
30     side-to-side or when the main body 210 is twisted about its longitudinal axis 211. A

yoke 235 connects the main body 210 to the cleaner head 230 in a manner which will be described in more detail below.

The main body 210 is rotatably connected to a roller assembly 220, which lies at the  
5 base of the main body 210. The roller assembly 220 allows the apparatus to be easily pushed or pulled along a surface. The shape of the roller assembly 220 and the connections between the main body 210 and the roller assembly 220, and the roller assembly 220 and the cleaner head 230, allow the apparatus to be more easily manoeuvred than traditional vacuum cleaners. On the left hand side the mechanical  
10 connection between the main body 210 and the roller assembly 220 is by an arm 540 which extends downwardly from the base of the main body 210. As shown in more detail in Figure 13, arm 540 includes a sleeve 541 for receiving a shaft 519 on which the roller shell 510 is rotatably mounted. On the right hand side of the machine, the connection between the main body 210 and the roller assembly 220 is by the flow ducts  
15 531, 535, as best seen in Figure 13.

The main body 210 has a handle 212 which extends upwardly from the top of the main body 210. The handle has a gripping section 213 by which a user can comfortably grip the handle and manoeuvre the apparatus. The gripping section can simply be a part of  
20 the handle which is specially shaped or treated (e.g. rubberised) to make it easy to grasp, or it can be an additional part which is joined to the handle at an angle to the longitudinal axis of the handle, as shown in Figures 3 - 6.

The outer shell 510 of the roller assembly 220 is shown in more detail in Figures 8 - 10.  
25 Conveniently, the outer shell 510 comprises two halves, one of which is shown in Figure 9, which can be secured together by fixings which locate in bores 586. In this embodiment, the overall shape of the roller 220 resembles a barrel. Looking at the shape of the outer surface in the direction along the longitudinal axis, there is a generally flat central region 580 and an arcuate region 585 at each end where the  
30 diameter, or width, of the shell 510 decreases. The central, flat region 580 has a

constant diameter and extends for around 25% of the total length of the roller assembly. We have found that a flat central region aids a user in steering the machine along a straight line, since the machine will naturally run straight and is less likely to wobble during backwards movements. The width of the central region can be increased or  
5 decreased as desired while still obtaining the benefit of the invention. The arcuate outer regions 585 allow the main body to roll towards one side when a user wishes to steer the machine in a different direction. Ridges 511 are provided on the outer surface of the roller shell 510 to improve grip over surfaces. It is also beneficial to provide a non-slip texture or coating on the outermost surface of the roller shell 510 to aid grip on slippery  
10 surfaces such as hard, shiny or wet floors. The length of the roller assembly is substantially equal to the width of the main body 210 of the vacuum cleaner. The provision of a continuous support surface across the width of the machine provides a reassuringly supportive feel to a user as the machine is manoeuvred through a wide range of operating positions. Alternatives to this shape of roller assembly are discussed  
15 later.

Referring to Figure 11, the shape of the roller surface is chosen such that the centre of mass 590 of the roller assembly always remains in a position in which it serves to right the machine. To demonstrate this, Figure 12 shows that even when the roller is turned  
20 onto its outermost edge, the centre of mass 590 will still lie to the right of a line 592 drawn perpendicular to the surface, and thus the roller assembly will have a tendency to return to a stable position.

The shape of the arcuate region 585 of the roller surface is also selected such that the  
25 length of an arc between the centre of mass 590 of the roller assembly and a point on the surface of the roller shell increases as one moves along the arcuate surface away from the central region 580. The effect of this shape is that it requires an increasingly greater force to turn the roller, as the roller is turned further from the normal straight running position. The diameter of the roller shell 510 at each end of its longitudinal axis  
30 determines the extent to which the main body can roll to one side. This is chosen such

that there will be sufficient clearance between the main body - and particularly the ducts 531, 535 at the point at which they enter the roller assembly - and the floor surface in this most extreme position.

5 The mechanical connection between the main body 210 and the cleaner head 230 is shown in Figures 6 and 7. In this embodiment, the connection between the main body 210 and the cleaner head 230 takes the form of a yoke 235 which is mounted to each end of the rotational axis 221 of the roller assembly 220. Further detail of the connection is shown in Figure 13. The yoke 235 can rotate independently of the main  
10 body 210. At the forward, central part of the yoke 235 there is a joint 237 with an arm 243. Arm 243 joins the yoke 235 to the cleaner head 230. The other end of arm 243 is pivotably mounted to the cleaner head 230 about pivot 241. The joint 237 is of the type where the respective pipes can slide against one another. The plane of this jointed connection 237 is shown by line 238. The plane 238 of the joint is formed at a non-  
15 normal angle to the longitudinal axis of the arm 243. We have found that an angle which is substantially perpendicular to the floor surface (when the machine is in the forward running position), or further inclined from this position to what is shown in Figure 6, works well. As arm 243 also carries airflow from the cleaner head 230, the joint 237 maintains an airtight seal as arm 243 moves with respect to yoke 235.

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This arrangement of the pivotal mounting 241 of the yoke 235 and joint 237, allows the main body 210 together with the roller assembly 220 to be rotated about its longitudinal axis 211, in the manner of a corkscrew, while the cleaner head 230 remains in contact with the floor surface. This arrangement also causes the cleaner head 230 to point in a  
25 new direction as the main body is rotated about its longitudinal axis 211. Figure 3 shows the position for forward or backward movement in a straight line while Figures 4 and 5 show the vacuum cleaner in two different turning positions. In Figure 3 the main body 210 is reclined into an operating position. The longitudinal axis 221 of the roller assembly 220 is parallel with the floor and with the longitudinal axis 231 of the cleaner  
30 head 230. Thus, the cleaner moves in a straight line. The main body can be moved

anywhere between a fully upright position, in which the longitudinal axis 211 of the main body is perpendicular to the floor surface, and a fully reclined position in which the longitudinal axis 211 of the main body lies substantially parallel to the floor surface.

5 Figure 4 shows the vacuum cleaner turning towards the left. The main body 210 is rotated anti-clockwise about its longitudinal axis 211. This raises the longitudinal axis 221 of the roller 220 assembly into a position which is inclined with respect to the floor and which is facing towards the left compared to the starting, straight running, position. The inclined joint 237 between the main body 210 and cleaner head 230 causes the  
10 cleaner head 230 to point towards the left. The pivotable connections between the yoke 235 and the main body 210, and between the arm 243 and the cleaner head 230, allow the cleaner head to remain in contact with the floor, even though the height of the yoke 235 varies as the main body is rotated. The arcuate region 585 of the roller allows the body to roll into this position, while still providing support for the main body 210. The  
15 extent to which the main body 210 is turned in the anti-clockwise direction determines the extent to which the cleaner head 230 moves from its forward facing position towards the left. The smaller diameter part 585 of the roller assembly not only allows the main body to roll onto one side, but tightens the turning circle of the vacuum cleaner.

20 Figure 5 shows the vacuum cleaner turning towards the right. This is the opposite to what was just described for turning to the left. The main body 210 is rotated clockwise about its longitudinal axis 211. This raises the longitudinal axis 221 of the roller assembly 220 into a position which is inclined with respect to the floor and which is facing towards the right compared to the starting, straight running, position. The joint  
25 237 between the main body 210 and cleaner head 230 causes the cleaner head 230 to point towards the right, while still remaining in contact with the floor. The arcuate region 585 of the roller allows the body to roll into this position, while still providing support for the main body 210. The extent to which the main body 210 is turned in the clockwise direction determines the extent to which the cleaner head 230 moves from its  
30 forward facing position towards the right.

The main body 210 houses separating apparatus 240, 245 which serves to remove dirt, dust and/or other debris from a dirty airflow which is drawn in by the fan and motor on the machine. The separating apparatus can take many forms. We prefer to use cyclonic separating apparatus in which the dirt and dust is spun from the airflow of the type described more fully in, for example, EP 0 042 723.

The cyclonic separating apparatus can comprise two stages of cyclone separation arranged in series with one another. The first stage 240 is a cylindrical-walled chamber and the second stage 245 is a tapering, substantially frusto-conically shaped, chamber or a set of these tapering chambers arranged in parallel with one another. In Figure 3, airflow is directed tangentially into the upper part of a first cyclonic chamber 240 by duct 236. Larger debris and particles are removed and collected in the first cyclonic chamber. The airflow then passes through a shroud to a set of smaller frusto-conically shaped cyclonic chambers. Finer dust is separated by these chambers and the separated dust is collected in a common collecting region. The second set of separators can be upright, i.e. with their fluid inlets and outlets at the top and their dirt outlets at the bottom, or inverted, i.e. with their fluid inlets and outlets at the bottom and their dirt outlets at the top. However, the nature of the dust separating apparatus is not material to the present invention and the separation of dust from the airflow could equally be carried out using other means such as a conventional bag-type filter, a porous box filter, an electrostatic separator or some other form of separating apparatus. For embodiments of the apparatus which are not vacuum cleaners, the main body can house equipment which is appropriate to the task performed by the machine. For example, for a floor polishing machine the main body can house a tank for storing liquid wax.

A fan and a motor for driving the fan, which together generate suction for drawing air into the apparatus, are housed in a chamber mounted inside the roller assembly 220.

A number of airflow ducts carry airflow around the machine. Firstly, an airflow duct connects the cleaner head 230 to the main body of the vacuum cleaner. This airflow duct is located within the left hand arm (Figure 3) of yoke 235. Another duct 236 carries the dirty airflow from the yoke 235 to separating apparatus 240 on the main body. A changeover mechanism is provided for selecting whether airflow from the yoke 235, or a separate hose on the machine, is carried to the separating apparatus 240. A suitable mechanism of this type is described more fully in our International Application WO 00/21425.

10. Another airflow duct 531 connects the outlet of the separating apparatus 245 to the fan and motor, within the roller assembly 220, and a further airflow duct 535 connects the outlet of the fan and motor to a post motor filter on the main body 210.

15. One or more filters are positioned in the airflow path downstream of the separating apparatus 240, 245. These filters remove any fine particles of dust which have not already been removed from the airflow by the separating apparatus 240, 245. We prefer to provide a first filter, called a pre-motor filter, before the motor and fan 520, and a second filter 550, called a post-motor filter, after the motor and fan 520. Where the motor for driving the suction fan has carbon brushes, the post-motor filter 520 also serves to trap any carbon particles emitted by the brushes.

25. Filter assemblies generally comprise at least one filter located in a filter housing. Commonly, two or three filters are arranged in series in the filter assembly to maximise the amount of dust captured by the filter assembly. One known type of filter comprises a foam filter which is located directly in the air stream and has a large dust retaining capacity. An electrostatic or HEPA grade filter, which is capable of trapping very small dust particles, such as particles of less than one micron, is then provided downstream of the foam filter to retain any dust which escapes from the foam filter. In such a known arrangement, little or no dust is able to exit the filter assembly. Examples of suitable

filters are shown in our International Patent Application numbers WO 99/30602 and WO 01/45545.

In this embodiment, the filter or filters are both mounted in the main body 210.

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Figure 13 shows a detailed cross-section through the roller assembly 220. The outer shell 510, which has previously been shown in Figures 8 - 10, is mounted such that it can rotate with respect to the main body 210. The main components within the roller shell 510 are a motor bucket 515 and a fan and motor unit 520. On the left hand side, a support arm 540 extends down from the main body 210 alongside the end face of the roller shell. A shaft 519 passes through a hole in the centre of the end face of the roller shell 510. Shaft 519 is supported by a sleeve in part 541 of arm 540. The roller shell 510 is rotatably supported on the shaft 519 by bearings 518. The shaft 519 extends along the longitudinal axis (and rotational axis) of the roller shell 510 to locate within a pocket 525 on the end face of the motor bucket 515. On the right hand side of the machine, the roller shell 510 has a much larger opening in its side face so as to accommodate inlet 531 and outlet 535 ducts. The inlet and outlet ducts 531, 535 serve a number of purposes. They provide support both for the roller shell 510 and the motor bucket 515 and they duct air into/out of the motor bucket 515. The roller shell 510 is rotatably supported on the motor bucket 515 by bearings 516. The motor bucket 515 is mounted in a fixed relationship to the main body 210 and support ducts, i.e. the motor bucket 515 moves with the main body and the support ducts while the roller shell 510 can rotate around the motor bucket 515 when the machine is moved along a surface. The motor bucket 515 fixes to the ducts 531, 535 by part 526. Ducts 531 and 535 communicate with the interior of the motor bucket 515. Duct 531 delivers airflow from the separating apparatus 240, 245 on the main body 210 directly to the inside of the motor bucket 515. Mounting the fan and motor unit within the motor bucket 515 helps to reduce noise since the motor bucket 515 and the roller shell 510 form a double-skinned housing for the fan and motor unit 520, with an air gap between the skins 510, 515.

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The fan and motor unit 520 is mounted within the motor bucket 515 at an angle to the longitudinal axis of the motor bucket 515 and the roller shell 510. This serves two purposes: firstly, it distributes the weight of the motor 520 evenly about the centre of the roller shell, i.e. the centre of gravity of the fan and motor unit is aligned with the centre of the gravity of the overall roller assembly, and secondly, it improves the airflow path from inlet duct 531 into the fan and motor unit 520. The fan and motor unit 520 is supported within the motor bucket 515 by fixings at each end of its longitudinal axis. At the left hand side, the cavity between outwardly extending ribs 521 receives part 522 of the motor. On the right hand side, an outwardly tapering funnel 532 joins inlet duct 531 to the inlet of the fan and motor unit 520. The downstream end of the funnel 532 has a flange 523 which fits around the fan and motor unit 520 to support the fan and motor unit 520. Further support is provided by a web 524 which surrounds the fan and motor unit 520 and fits between flange 523 and the inner face of the motor bucket 515. The funnel 532 also ensures that incoming and outgoing airflows from the motor bucket are separated from one another.

Air is carried to the fan and motor unit 520 within the roller assembly by inlet duct 531 and funnel 532. Once airflow has passed through the fan and motor unit 520, it is collected and channelled by the motor bucket 515 towards the outlet duct 535. Outlet duct 535 carries the airflow to the main body 210.

Outlet duct 535 connects to the lower part of the main body 210. Part 552 of the main body is a filter housing for the post motor filter 550. Air from duct 535 is carried to the lower face of the filter housing, passes through filter 550 itself, and can then exhaust to atmosphere through venting apertures on the filter housing 552. The venting apertures are distributed around the filter housing 552.

A stand assembly 260, 262 is provided on the machine to provide support when the machine is left in an upright position. The stand assembly is arranged so that it is

automatically deployed when the main body 210 is brought towards the fully upright position, and is retracted when the main body 210 is reclined from the fully upright position.

- 5 There are a wide range of alternative configurations to what has just been described and a number of these will now be described.

In the embodiment just described, airflow is ducted into and out of the roller shell 510, from one side of the roller shell, and the space within the roller shell 510 is used to  
10 house a motor bucket 515 and the fan and motor unit 520. Other uses can be made of the space inside the roller shell 510 and Figures 14 - 16 show some of these alternatives. In each of Figures 14 - 16 a filter is housed within the roller shell 600. In Figure 14 a cylindrical filter assembly 605 is housed within the roller shell 600 with its longitudinal axis aligned with that of the roller shell. An inlet airflow duct 601 carries  
15 air from the outlet of the separating apparatus 240, 245 on the main body 210 of the vacuum cleaner to the interior of the roller shell 600. An outlet airflow duct 602 carries airflow from the interior of the roller shell 600. The roller shell is rotatably mounted about ducts 601, 602 on bearings 603. Filter 605 is supported by the ducts 601, 602. In use, air flows from inlet duct 601, around the outside of filter 605 and radially inwards,  
20 through the filter medium, to the central core of the filter 605. The air can then flow along the core and exit the roller shell 600 via outlet duct 602.

In Figure 15, a filter 610 is mounted transversely across the roller shell 600. The inner surface of the roller shell 610 can be provided with suitable fixings for securing the  
25 filter 610 in place. The air flow in Figure 15 is much simpler. Air flows from inlet duct 611, through the interior of the roller shell 600, through filter medium 610 and then leaves the roller shell via outlet duct 612. The filter material can include foam and filter paper which is either flat or pleated to increase the surface area of filter medium presented to the airflow.

## 16

Figure 16 is similar to Figure 14 in that a filter 625 is mounted with its longitudinal axis aligned with that of the roller shell 600. The notable difference is that air can exhaust directly to atmosphere from via apertures 608 in the roller shell 600. Duct 622 provides mechanical support for the roller shell and does not carry airflow.

5

To gain access to the filter a hatch can be provided in the roller shell 600. However, as many filters are now lifetime filters, which do not require changing during the normal lifetime of the machine, it can be acceptable to fit the filter within the roller shell in a less accessible manner.

10

In each of these embodiments it is possible to provide an inner shell within the roller shell 600, in the same manner as motor bucket 515 was provided in Figure 13. The inner shell will be sealed to the inlet and outlet ducts, thus alleviating the sealing requirements of the roller shell.

15

In Figures 14 and 15 the exhaust duct can be mounted on the same side of the roller assembly as the inlet duct. The two ducts can be mounted in a side-by-side relationship, as previously shown in Figure 13, or one duct can surround the other duct, as shown later in Figure 18.

20

Figure 17 shows an alternative arrangement for mounting a fan and motor unit inside the roller assembly. As with the arrangement shown in Figure 13, there is a roller shell 700 with a motor bucket 715 mounted inside, and the roller shell 700 can rotate around the motor bucket 715. An inlet airflow duct carries air to the fan and motor unit 520.

25

However, in this embodiment, a filter 710 is positioned downstream of the fan and motor, inside motor bucket 715. Air is exhausted directly from the roller assembly via an outlet 705. The outlet 705 is positioned next to the support arm 702 on the hub of roller 700. This means that air outlet 705 remains stationary as the roller 700 rotates. As a further alternative, the filter 710 could be omitted altogether. Where the motor is a

30

brushless motor, such as a switched reluctance motor, there will not be any carbon

emissions from the motor and thus there is less need for a post-motor filter. When air is directly exhausted from the roller assembly in this manner there is an option of still providing the second support arm 702 (which does not carry airflow), or the second support arm 702 can simply be omitted and all of the support for the roller assembly is provided by the first support arm.

In another alternative embodiment, separating apparatus can be housed inside the roller assembly.

#### 10 Shape of roller

The embodiment shown in Figures 3 - 13 has a barrel shaped roller with a flat central region and tapering end regions. Figures 18 - 21 show a range of alternative roller shapes. This list is not intended to be exhaustive and other shapes, not illustrated, are intended to fall within the scope of the invention. The roller, or set of rolling members, can have a substantially spherical shape, as shown in Figure 18, or a spherical shape with truncated faces 811, 812 as shown in Figure 19. A true sphere has the advantage that the force required to turn the roller remains constant as the main body is turned from a straight running position, since the length of the arc between the centre of mass and surface remains constant. Also, because the length of the arc between the geometric centre of the roller assembly and the outer surface remains constant, the height of joint 237 between yoke 235 and the cleaner head 230 remains constant as the main body is rotated about its longitudinal axis 211. This simplifies the jointing requirements between the main body and the cleaner head 230.

Truncating the end faces of the sphere has the benefits of reducing the width of the roller and removing a part of the surface which is not likely to be used. Also, the ducts entering and leaving the roller are likely to make contact with the floor if the machine were allowed to roll onto the outer most part of the surface. Figure 20 shows a sphere with a central flat region 813 and Figure 21 shows a central ring 814 of constant diameter with a hemisphere 815, 816 at each end.

The embodiments shown above provide a roller assembly with a single rolling member. A larger number of parts can be provided. Figures 22 - 24 show embodiments where the roller assembly comprises a pair of shell-like parts 731, 732. Each part is independently rotatable. Part 731 is rotatable about a combined support arm and duct 735, 736 and part 732 is rotatable about combined duct and support arm 740. A motor bucket 742 fits within the rotatable parts 731, 732 and supports fan and motor unit 743. An advantage in providing two shell-like parts 731, 732 is that the space between parts 731, 732, in the direction along the rotational axis of the parts 731, 732, can be used to accommodate a duct 745 which carries air from the cleaner head 230 to the interior of the roller assembly; a mechanical connection between the cleaner head and the roller assembly, or both of these features. In Figures 23 and 24 a combined mechanical connection and air duct 741 is connected to the front of the motor bucket 742, in the space between parts 731, 732, passes inside the motor bucket 742, and then extends in a direction which is aligned with the rotational axis of part 732. Outlet duct 740 provides mechanical support for part 732 as well as carrying air flow to the main body of the vacuum cleaner. There are two ways in which the required degree of articulation between the duct 745 and main body can be achieved. Firstly, duct 745 can be pivotably mounted to the motor bucket 742. Secondly, the duct 745 can be rigidly mounted to the motor bucket 742 and the motor bucket 742 is rotatably mounted to the support arms 735, 736 and 740.

The space between the two rotatable parts 731, 732 can be used to accommodate a driving connection between a motor inside the motor bucket 742 to a brush bar on the cleaner head 230. The driving connection can be achieved by a belt and/or gears.

As shown in Figure 25, the rotational axis of each rolling member need not be aligned with one another. Here the rotational axes 821, 822 of rolling members 823, 824 are each inclined inwardly from the vertical.

It is also possible to provide three or more rotatable parts. Indeed, there can be a much large number of adjacent parts which are each free to rotate about an axle as the apparatus is moved along a surface. The set of rotatable parts can all be mounted about a linear axis, with the diameter of each part decreasing with distance from the central region of the axis. Alternatively, as shown in Figure 26, the rotatable parts 825 can all have the same or similar size and are mounted about an axis 826 which has the shape which is required from the lower surface of the roller assembly. The rotatable parts 825 can be small, solid parts which are mounted about a shaft, or they can be larger, hollow, annular parts which are rotatably mounted about a housing whose longitudinal axis is non-linear. The housing can accommodate a motor or filter, as previously described.

In each embodiment, the shape of the roller assembly, or set of rotatable parts, defines a support surface which decreases in diameter towards each end of the rotational axis so as to allow the main body to turn with ease. As in the embodiment described above, it is preferred that the central region of the rotatable part, or set of parts, is substantially flat as this has been found to increase stability of the apparatus when it is driven in a straight line.

#### Connection between main body and the roller assembly

Referring again to Figures 6 and 7, the connection between the main body 210 and the cleaner head 230 is via a yoke 235 which has a joint 237 formed at a plane which is inclined to the longitudinal axis of arm 243. The angle of the plane 238 in which the joint lies can be varied from what is shown here. We have found that forming the joint 237 such that the plane 238 of the joint is normal with the longitudinal axis of the arm 243 is acceptable, but does not provide the full advantage of the invention since rotating the yoke does not cause arm 243 (and hence the cleaner head 230) to turn. Forming the joint 237 such that the plane 238 of the joint is inclined with the longitudinal axis of the arm 243, and substantially perpendicular to the floor surface (with the machine in a forward running position) provides good results. Inclining the plane 238 still further to

what is shown in Figure 6, or further still, increases the extent to which cleaner head 230 will move when the main body is rotated about its longitudinal axis.

5 The connection between arm 243 and cleaner head 230 is shown in Figures 6 and 7 as a true pivot with a shaft. We have found that while some degree of pivotal movement is required at this position, this movement can be achieved by a more relaxed form of jointed connection.

10 Figure 27 shows an alternative form of the connection between the main body 210 and the cleaner head 230. As previously, there is a yoke 235, each end of the yoke connecting to the main body about the rotational axis 221 of the roller assembly. Also, there is a short arm 243 which is pivotably connected to the cleaner head 230. The difference is at the forward face of the yoke 235. Instead of a rotating joint which is inclined at an angle to the longitudinal axis of the arm 243, there is a rotating joint  
15 which is formed at an angle which is normal to the longitudinal axis of the arm 243 and the part of the yoke 235 which joins arm 243 at joint 852 has an elbow shape 851. The combination of an elbow shape and a joint at a normal angle has been found to be equivalent to providing a joint at an inclined angle. This alternative scheme can be more cumbersome to implement as it requires more space between the cleaner head 230  
20 and the roller assembly 220.

The supports between the main body and the cleaner head do not have to be rigid. Figure 28 shows a pair of flexible support tubes 831, 832 which connect the roller assembly 830 to the cleaner head 833. Where flexible tubes are used, the cleaner head  
25 can freely remain in contact with the floor surface as the main body is rolled from side-to-side or twisted about its longitudinal axis. The use of flexible tubes in this manner avoids the need for a more complex arrangement of mechanical joints between the main body and the cleaner head.

21

In each of the embodiments shown and described above airflow ducts have been used, wherever possible, to provide mechanical support between parts of the machine, e.g. between the main body 210 and roller assembly 220 and between the cleaner head 230 and main body 210 by yoke 235. This requires the ducts to be suitably sealed. It should  
5 be understood that in each embodiment where the features of a flow duct and mechanical support have been combined, separate supports and flow ducts can be substituted in their place. The flow duct can be a flexible or rigid pipe which lies alongside the mechanical support.

10 Although there are advantages in housing the motor inside the roller assembly, in an alternate embodiment, the fan and motor can be housed in the main body. This simplifies the ducting requirements on the machine since there only needs to be a duct from the cleaner head to the main body. Support arms are still required between the main body and the roller assembly and between the main body and the cleaner head.

15 While the illustrated embodiment shows a vacuum cleaner in which ducts carry airflow, it will be appreciated that the invention can be applied to vacuum cleaners which carry other fluids, such as water and detergents.

20



**Claims**

1. A surface treating appliance comprising a main body and a support assembly which is rotatably mounted to the main body for allowing the main body to be moved  
5 along a surface, wherein the support assembly comprises a fluid inlet for receiving fluid flow, a fluid outlet for exhausting fluid and means for acting on the fluid flow received through the inlet.
2. An appliance according to claim 1 wherein the means for acting on the fluid  
10 flow is mounted within the support assembly such that a rolling surface of the support assembly rotates around the means for acting on the fluid flow.
3. An appliance according to claim 2 further comprising a shell, mounted within  
15 the support assembly, for supporting the means for acting on the fluid flow, and wherein a rolling surface of the support assembly is rotatably mounted about the shell.
4. An appliance according to claim 1 wherein the means for acting on the fluid  
20 flow is mounted within the support assembly such that it rotates with the support assembly during movement of the support assembly.
5. An appliance according to any one of the preceding claims wherein the means  
for acting on the fluid flow comprises suction-generating means.
6. An appliance according to claim 5 wherein the suction-generating means is an  
25 impeller and a motor for driving the impeller.
7. An appliance according to any one of the preceding claims wherein the means  
for acting on the fluid flow comprises a filter.

8. An appliance according to claim 7 wherein the filter is a cylindrical filter with a longitudinal axis and wherein the filter is positioned within the support assembly such that fluid passes radially through the filter.

5 9. An appliance according to claim 8 wherein one of the fluid inlet or outlet to the filter lies along the longitudinal axis of the filter and the other of the fluid inlet or outlet lies around the circumference of the filter.

10 10. An appliance according to any one of the preceding claims wherein the means for acting on the fluid flow is separating apparatus for separating entrained matter from the fluid flow.

15 11. An appliance according to any one of the preceding claims wherein the fluid outlet from the support assembly comprises a plurality of apertures in the surface of the support assembly.

12. An appliance according to any one of claims 1 to 10 wherein the fluid outlet from the support assembly is an outlet duct.

20 13. An appliance according to claim 12 wherein the outlet duct is substantially coaxial with the axis of rotation of the support assembly.

14. An appliance according to claim 12 or 13 wherein the inlet duct also provides support between the main body and the support assembly.

25

15. An appliance according to any one of the preceding claims wherein the fluid inlet is an inlet duct.

30 16. An appliance according to claim 15 wherein the inlet duct is substantially coaxial with the axis of rotation of the support assembly.

17. An appliance according to claim 15 or 16 wherein the inlet duct provides support between the main body and the support assembly.

5 18. An appliance according to any one of the preceding claims wherein the fluid inlet and fluid outlet are positioned on the same side of the support assembly.

19. An appliance according to claim 18 wherein one of the fluid inlet or outlet surrounds the other of the fluid inlet or outlet.

10

20. An appliance according to any one of the preceding claims wherein the main body comprises separating apparatus for separating entrained matter from the fluid flow.

15 21. An appliance according to claim 18 wherein the air inlet to the support assembly receives fluid flow from the separating apparatus.

22. An appliance according to any one of the preceding claims wherein the fluid is air.

20 23. A surface treating appliance comprising a main body and a support assembly which is rotatably mounted to the main body for allowing the main body to be moved along a surface, wherein the support assembly houses a motor for driving a component of the appliance.

25 24. A surface treating appliance according to claim 23 wherein the motor drives a surface treating means.

25. A surface treating appliance according to claim 24 wherein the surface treating means comprises a surface agitating device.

30

## 25

26. A surface treating appliance according to claim 25 wherein the surface agitating device comprises a brush bar.

27. A surface treating appliance according to claim 25 wherein the surface treating  
5 means comprises a surface polishing device.

28. A surface treating appliance according to any one of claims 23 - 27 wherein the motor drives a suction-generating means.

10 29. A surface treating appliance according to claim 28 wherein the support assembly comprises a fluid inlet for receiving fluid flow and a fluid outlet for exhausting fluid.

30. A surface treating appliance according to claim 29 wherein the rolling surface of the support assembly rotates around the motor.

15

31. A surface treating appliance according to claim 30 further comprising a shell, mounted within the support assembly, for supporting the motor, and wherein the rolling surface of the support assembly is rotatably mounted about the shell.

20 32. A surface treating appliance according to any one of claims 23 - 31 wherein the fluid outlet from the support assembly comprises a plurality of outlet apertures in the surface of the support assembly.

25 33. A surface treating appliance according to any one of claims 23 - 32 wherein the fluid outlet from the support assembly comprises a plurality of outlet apertures in a hub of the support assembly.

34. A surface treating appliance according to any one of claims 23 - 31 wherein the fluid outlet from the support assembly is an outlet duct.

30

- 35 A surface treating appliance according to claim 34 wherein the outlet duct is substantially coaxial with the axis of rotation of the support assembly.
- 36 A surface treating appliance according to claim 34 or 35 wherein the inlet duct  
5 also provides support between the main body and the support assembly.
- 37 A surface treating appliance according to any one of claims 23 - 36 wherein the fluid inlet is an inlet duct.
- 10 38 A surface treating appliance according to claim 37 wherein the inlet duct is substantially coaxial with the axis of rotation of the support assembly.
- 39 A surface treating appliance according to claim 37 or 38 wherein the inlet duct provides support between the main body and the support assembly.
- 15 40 A surface treating appliance according to any one of claims 23 - 39 wherein the support assembly houses a filter.
- 41 A surface treating appliance according to any one of claims 23 - 40 wherein the  
20 longitudinal axis of the motor is inclined with respect to the longitudinal axis of the support assembly.
- 42 A surface treating appliance according to any one of claims 23 - 41 wherein the motor is housed within the support assembly such that the centre of mass of the motor is  
25 aligned with the centre of the support assembly.
- 43 A surface treating appliance according to any one of claims 23 - 42 wherein the fluid is air.

44. A surface treating appliance comprising a generally upright main body having a longitudinal axis, a support assembly which is rotatably mounted to the base of the main body for allowing the main body to be moved along a surface, and a surface treating head, wherein the support assembly comprises one or more rotatable members having an  
5 outer surface which defines a substantially continuous support surface in the direction perpendicular to the longitudinal axis of the main body, the support surface being symmetrical about the longitudinal axis of the main body.

45. A surface treating appliance according to claim 44 wherein the support surface  
10 extends for a distance which is at least 50% of the width of the main body.

46. A surface treating appliance according to claim 45 wherein the support surface extends for a distance which is at least 75% of the width of the main body.

15 47. A surface treating appliance according to any one of claims 44 – 46 wherein the support surface extends for a distance which is substantially equal to the width of the main body.

48. A surface treating appliance according to claim 44 wherein the height of the  
20 lower, floor-engaging, surface of the support assembly increases towards each end of the support assembly.

49. A surface treating appliance according to claim 48 wherein the support assembly has a rotational axis which is substantially linear and which is substantially perpendicular  
25 to the longitudinal axis of the main body and wherein the diameter of the support assembly decreases in the region towards each end of the rotational axis.

50. A surface treating appliance according to claim 49 wherein the central portion of the support assembly has a substantially constant diameter.

51. A surface treating appliance according to claim 49 wherein, in the region towards each end of the rotational axis, the diameter of the support assembly is selected such that the length of an arc between the geometric centre of the assembly and the surface increases.

5

52. A surface treating appliance according to claim 49 wherein the support assembly is substantially spherical in shape.

10

53. A surface treating appliance according to any one of claims 44 - 52 wherein the support assembly comprises a single rotatable part.

54. A surface treating appliance according to any one of claims 44 - 48 wherein the support assembly has a rotational axis which is non-linear.

15

55. A surface treating appliance according to any one of claims 44 - 54 wherein the centre of mass of the support assembly is positioned such that it serves to return the support assembly to a normal position when the support assembly is moved from that position.

20

56. A surface treating appliance according to any one of claims 44 - 55 wherein the rotatable member, or members, are hollow parts which are mounted about a chamber.

25

57. A surface treating appliance according to any one of claims 44 - 56 wherein the support assembly comprises a fluid inlet for receiving fluid flow, a fluid outlet for exhausting fluid and means for acting on the fluid flow received through the inlet.

58. An appliance according to claim 57 wherein the means for acting on the fluid flow is mounted within the support assembly such that the support surface rotates around the means for acting on the fluid flow.

30

59. An appliance according to claim 58 further comprising a shell, mounted within the support assembly, for supporting the means for acting on the fluid flow, and wherein the support surface of the support assembly is rotatably mounted about the shell.

5 60. An appliance according to any one of claims 44 – 59 wherein the means for acting on the fluid flow comprises suction-generating means.

61. An appliance according to any one of claims 44 – 60 wherein the support assembly houses a motor for driving a component of the appliance.

10

62. A surface treating appliance comprising a main body, a surface treating head, a support assembly rotatably mounted to the base of the main body and a linkage between the main body and the surface treating head, wherein the linkage is arranged such that rotating the main body about its longitudinal axis causes the surface treating head to turn in a new direction.

15

63. A surface treating appliance according to claim 62 wherein the linkage is also arranged to allow the surface treating head to remain substantially in contact with the surface as the main body is rotated about its longitudinal axis.

20

64. A surface treating appliance comprising a main body, a support assembly rotatably mounted to the base of the main body for allowing the main body to be moved along a surface, the rotational axis of the support assembly being substantially perpendicular to the longitudinal axis of the main body, a surface treating head and a linkage between the main body and the surface treating head which allows the surface treating head to remain substantially in contact with the surface as the main body is rotated about its longitudinal axis.

25



65. A surface treating appliance according to claim 64 wherein the linkage is also arranged such that rotating the main body about its longitudinal axis causes the surface treating head to turn in a new direction.

5 66. A surface treating appliance according to any one of claims 62 – 65 wherein the linkage comprises a pivotable connection between the linkage and the surface treating head at the end of the linkage nearest the surface treating head.

67. A surface treating appliance according to claim any one of claims 62 – 66  
10 wherein the linkage comprises a pivotable connection between the linkage and the main body at the end of the linkage nearest the main body.

68. A surface treating appliance according to claim 67 wherein the pivotable  
15 connection to the main body is substantially aligned with the rotational axis of the support assembly.

69. A surface treating appliance according to claim 68 wherein the linkage  
20 comprises a yoke, each end of the yoke having a pivotable connection to the main body which is substantially aligned with the rotational axis of the support assembly.

70. A surface treating appliance according to claim 69 wherein a central part of the  
yoke couples to a central part of the surface treating head.

71. A surface treating appliance according to any one of claims 62 – 70 wherein the  
25 linkage connects to a central part of the surface treating head.

72. A surface treating appliance according to any one of claims 62 – 71 wherein the  
linkage comprises a jointed arm, the plane of the joint lying at a non-normal angle to the longitudinal axis of the arm.

73. A surface treating appliance according to any one of claims 62 - 71 wherein the linkage comprises an arm which has an elbow shape and a rotatable joint.

74. A surface treating appliance according to any one of claims 62 - 73 wherein the linkage between the main body and the surface treating head comprises at least one flexible tube.

75. A surface treating appliance according to any one of claims 62 - 74 wherein the support assembly comprises one or more rotatable members having an outer surface which defines a support surface in the direction perpendicular to the longitudinal axis of the main body, the support surface being symmetrical about the longitudinal axis of the main body.

76. A surface treating appliance according to claim 75 wherein the central region of the support assembly does not have a support surface.

77. A surface treating appliance according to claim 76 further comprising a support arm for the surface treating head which extends outwardly from the central region of the support assembly.

78. A surface treating appliance according to claim 76 or 77 further comprising a duct for carrying fluid to/from the surface treating head which extends outwardly from the central region of the support assembly.

79. A surface treating appliance according to claim 78 wherein the support arm is a fluid flow duct for carrying fluid to/from the surface treating head.

80. A surface treating appliance according to any one of claims 75 - 79 wherein the support surface extends for a distance which is at least 50% of the width of the main body.

81. A surface treating appliance according to claim 80 wherein the support surface extends for a distance which is at least 75% of the width of the main body.

5 82. A surface treating appliance according to any one of claims 62 - 81 wherein the support surface extends for a distance which is substantially equal to the width of the main body.

83. A surface treating appliance according to any one of claims 75 - 82 wherein the height of the lower, floor-engaging, surface of the support assembly increases towards each end of the support assembly.

84. A surface treating appliance according to claim 83 wherein the support assembly has a rotational axis which is substantially linear and which is substantially perpendicular to the longitudinal axis of the main body and wherein the diameter of the support assembly decreases in the region towards each end of the rotational axis.

85. A surface treating appliance according to claim 84 wherein the central portion of the support assembly has a substantially constant diameter.

20

86. A surface treating appliance according to claim 84 wherein, in the region towards each end of the rotational axis, the diameter of the support assembly is selected such that the length of an arc between the geometric centre of the assembly and the surface increases.

25

87. A surface treating appliance according to claim 84 wherein the support assembly is substantially spherical in shape.

88. A surface treating appliance according to any one of claims 75 - 87 wherein the support assembly comprises a single rotatable part.

30

89. A surface treating appliance according to claim 62 or 64 incorporating a support assembly according to any one of claims 44 - 61.

5 90. A surface treating appliance according to any one of the preceding claims in the form of a vacuum cleaning appliance.

91. A surface treating appliance substantially as described herein with reference to the accompanying drawings.

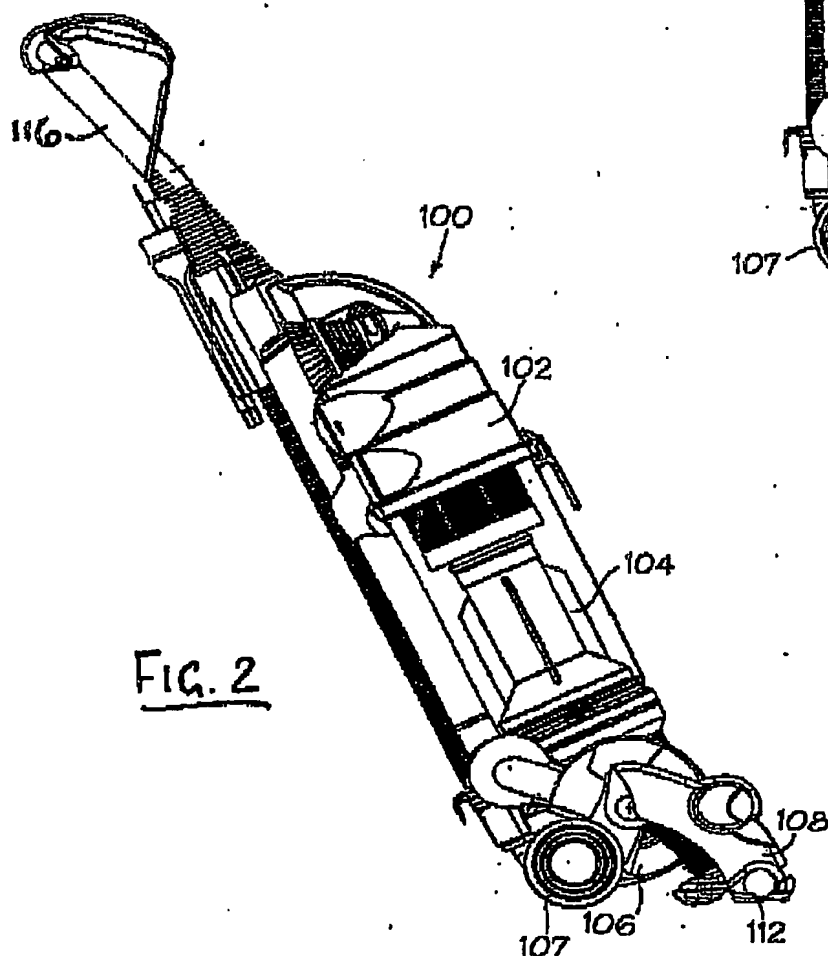
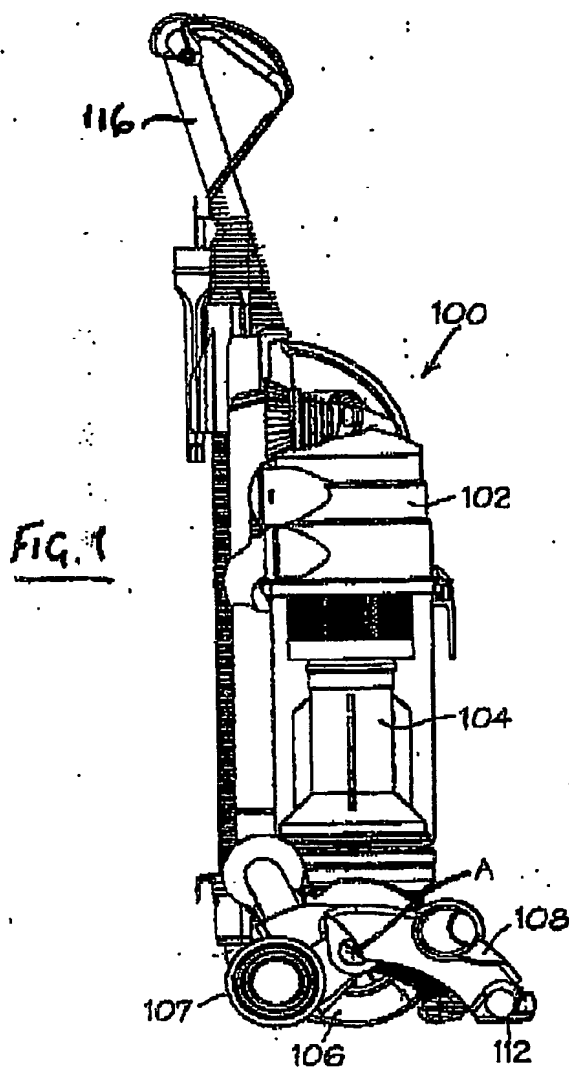
**ABSTRACT****Surface Treating Appliance**

- 5 A surface treating appliance (200) comprises a main body (210) and a support assembly (220) which is rotatably mounted to the main body (210) for allowing the main body (210) to be moved along a surface. The support assembly (220) has a fluid inlet (531) for receiving fluid flow and a fluid outlet (535) for exhausting fluid. A motor and fan unit (520, Figure 13) is housed within the support assembly.

10

(Figure 3)

1/12

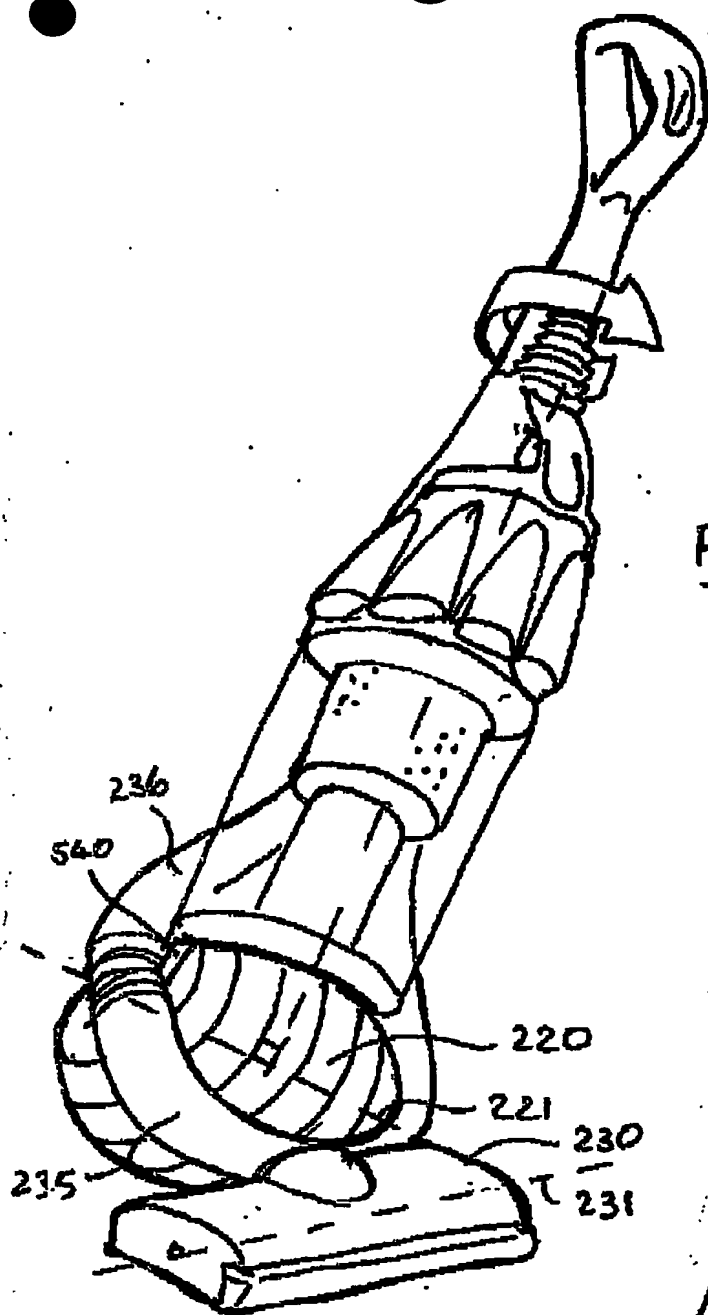




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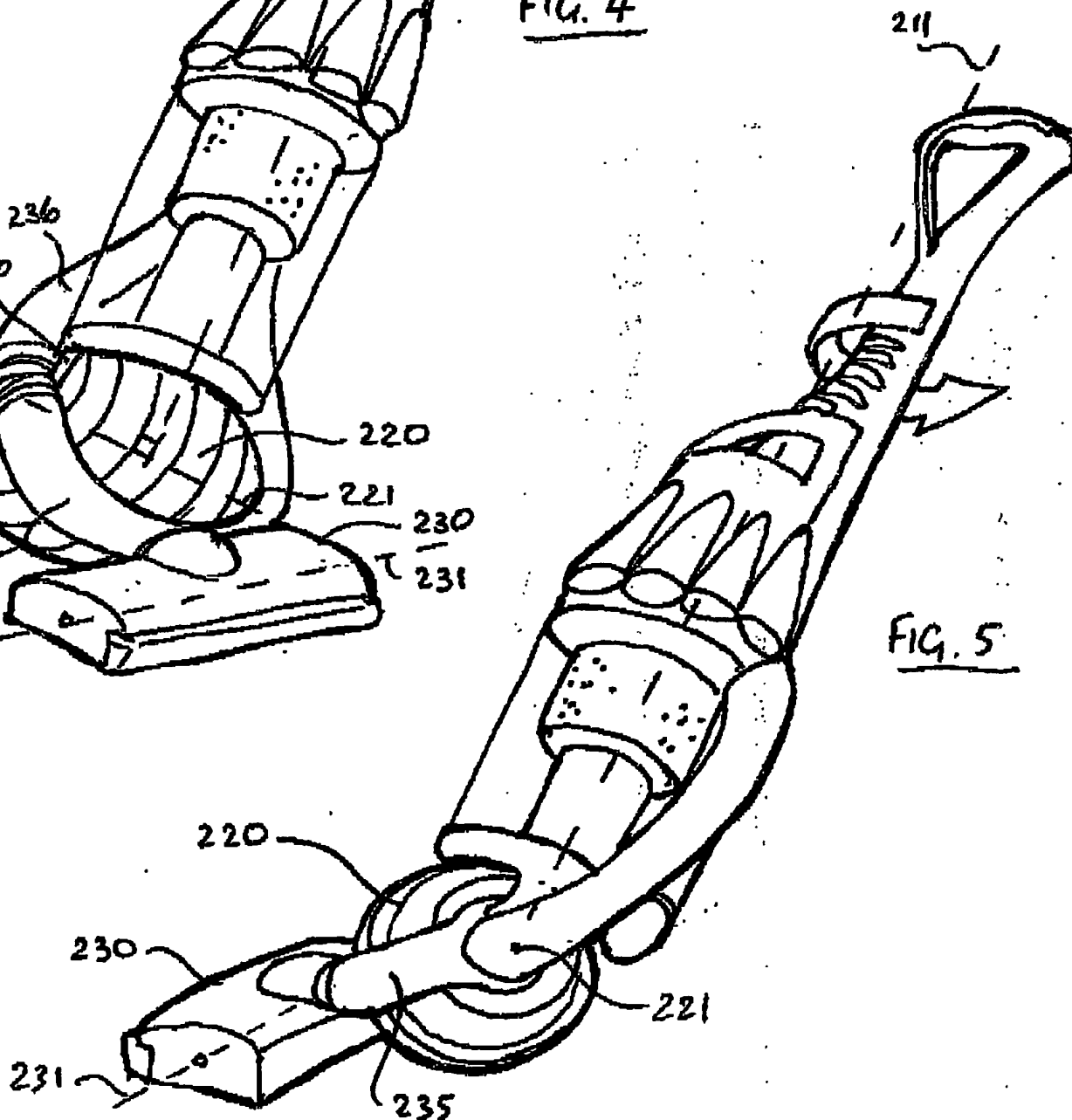
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FIG. 4



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FIG. 5





4/12

FIG. 6

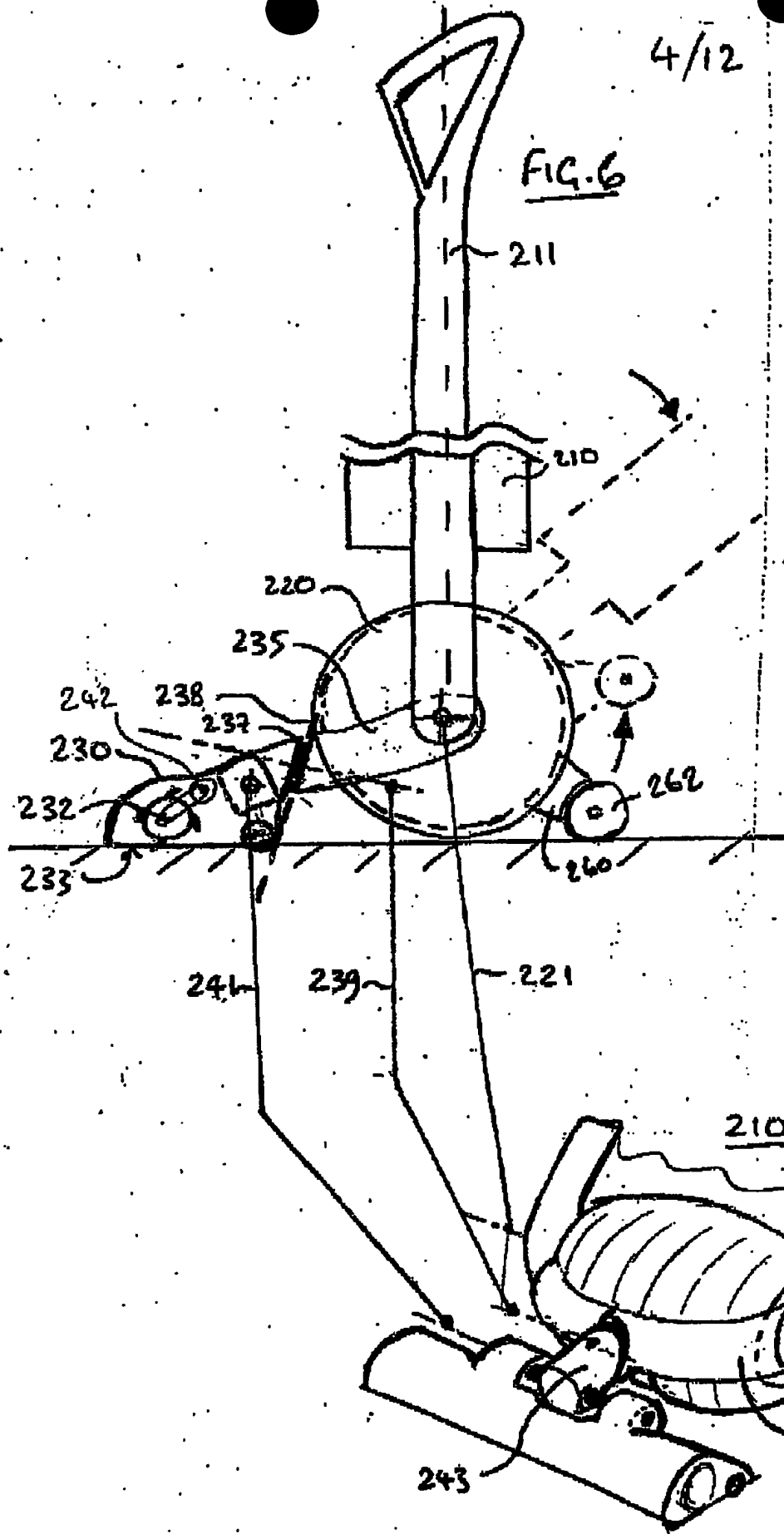
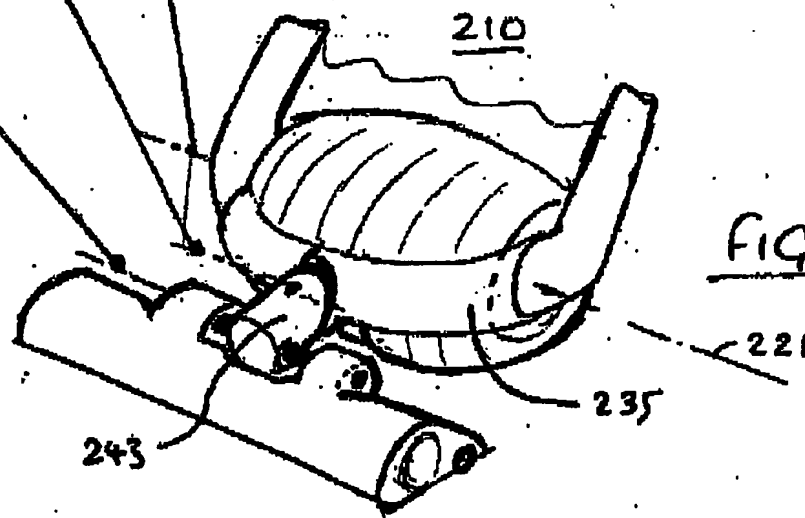
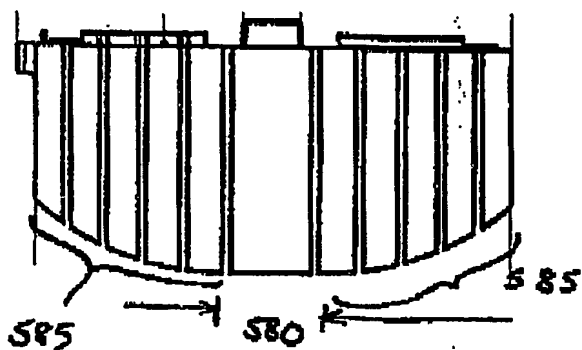
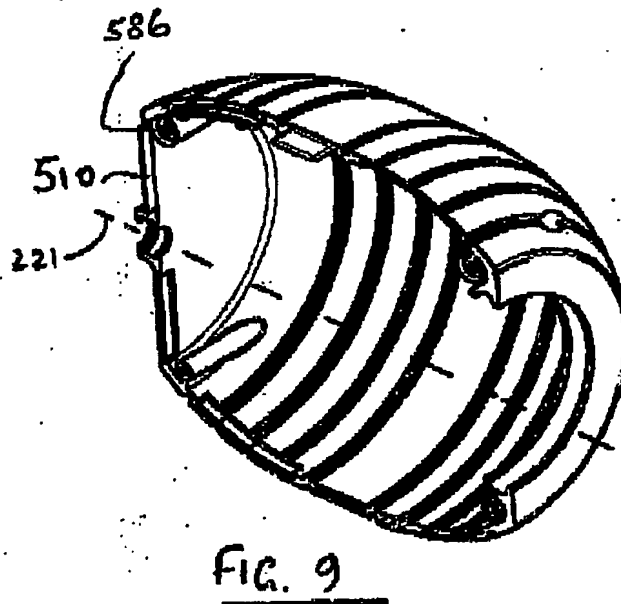
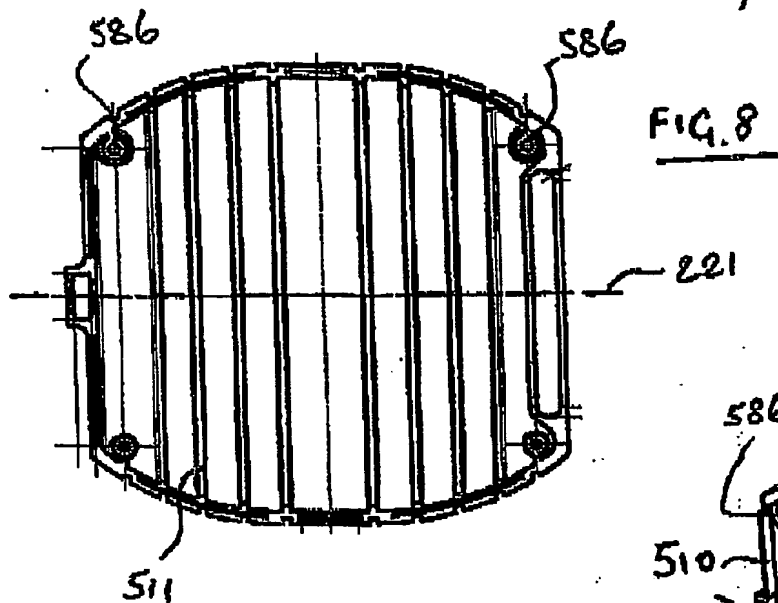


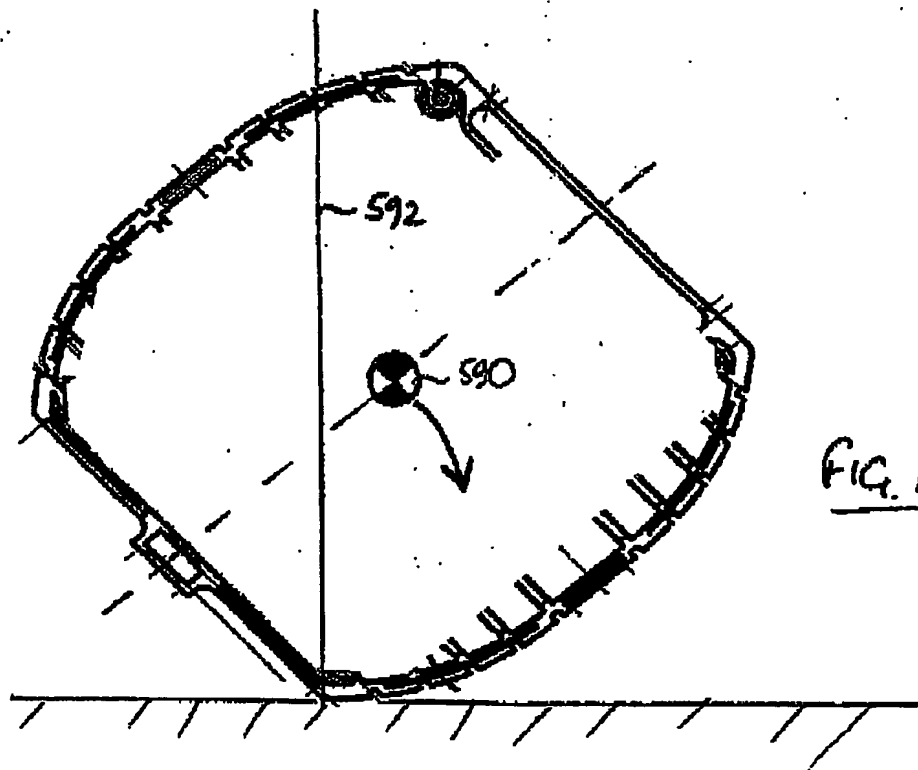
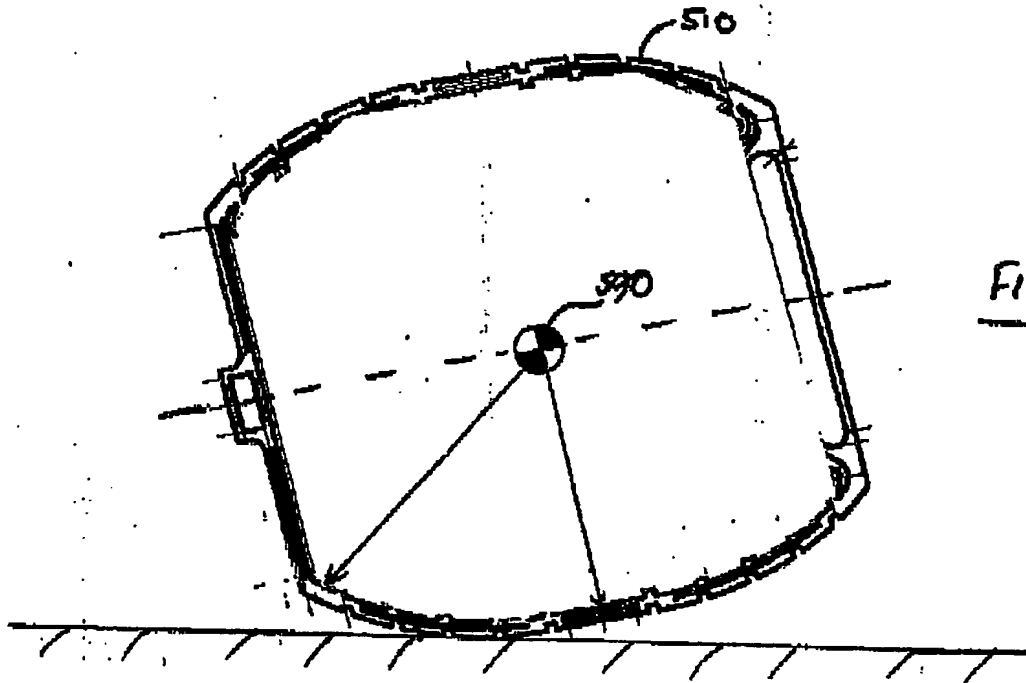
FIG. 7



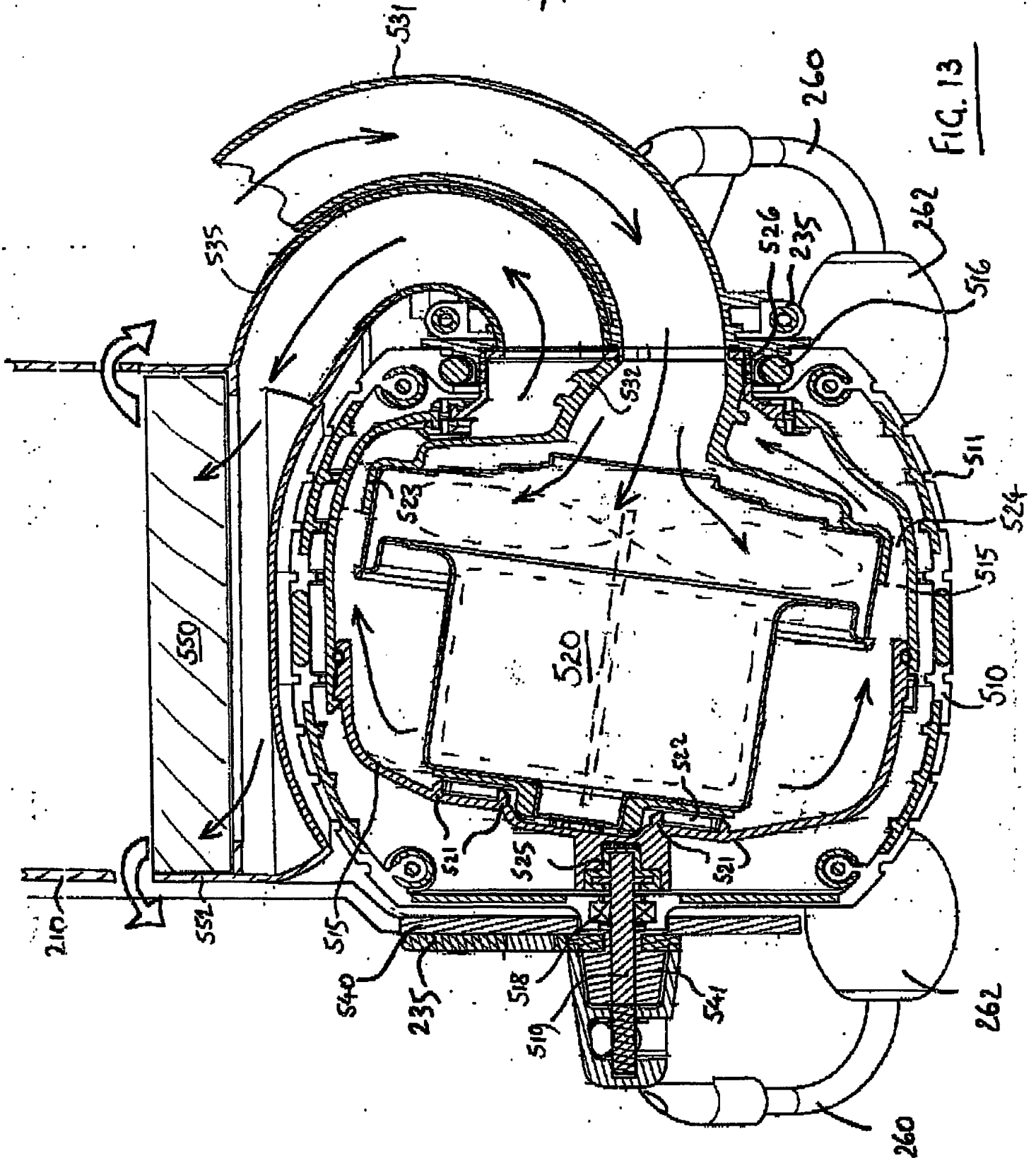
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6/12



7/12



8/12

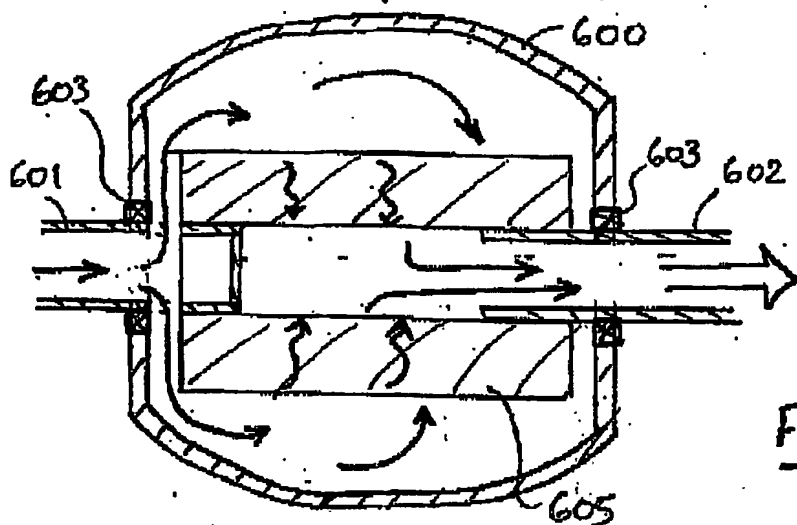


FIG. 14

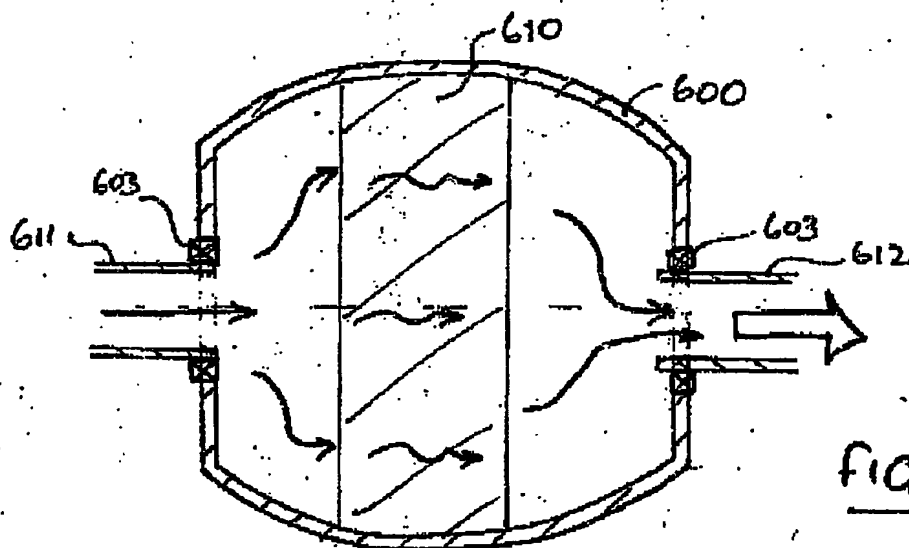


FIG. 15

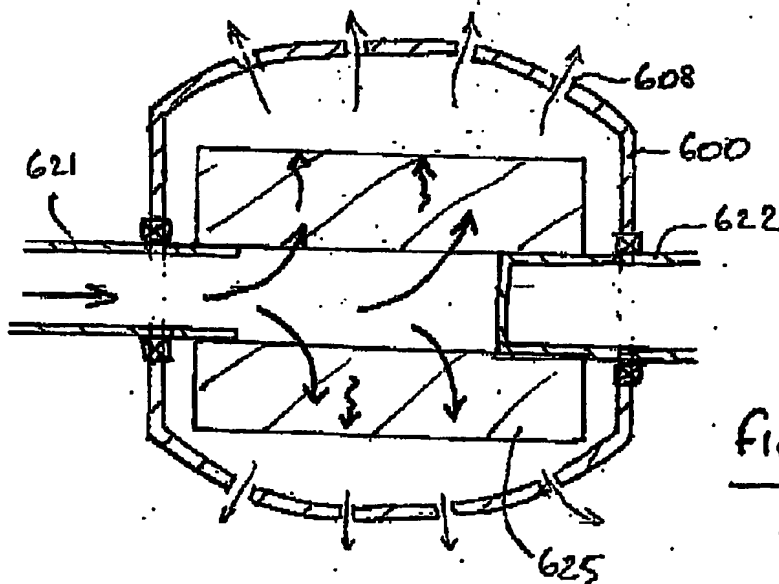


FIG. 16

9/12

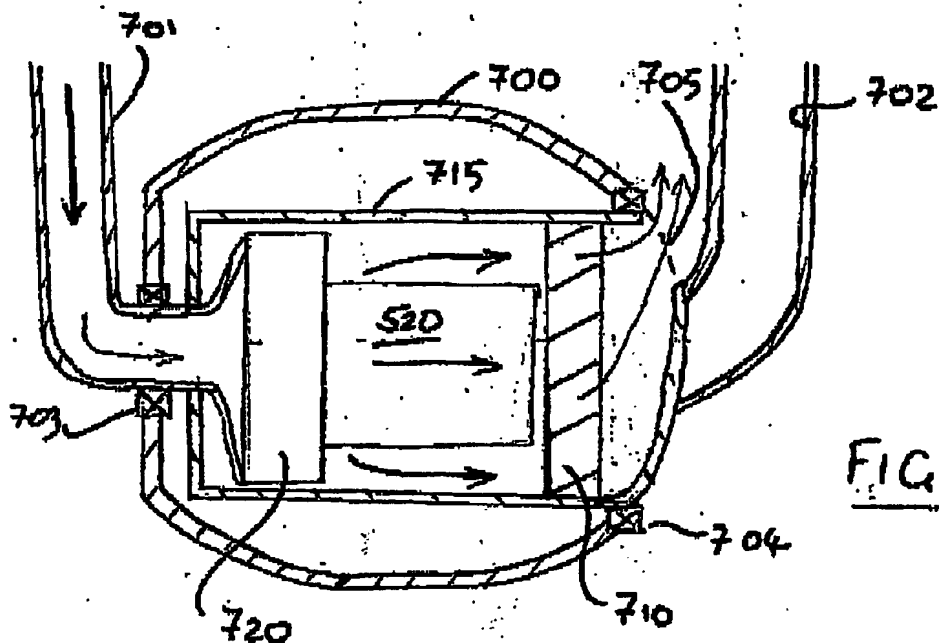


FIG. 17

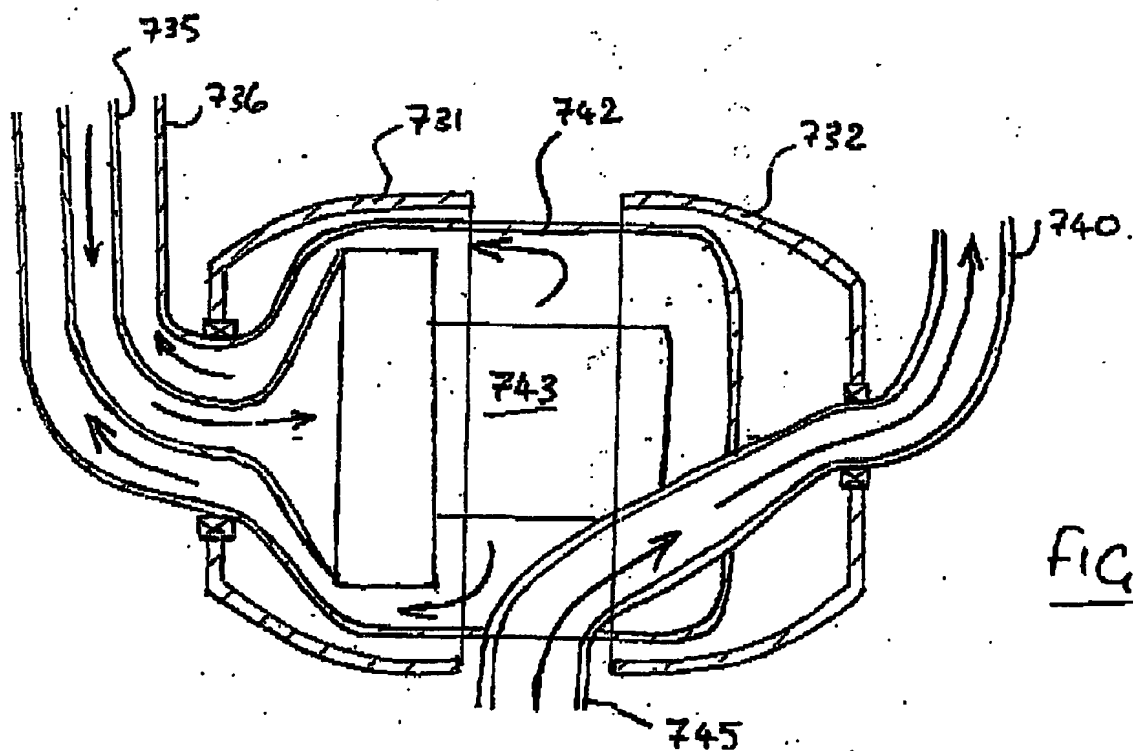
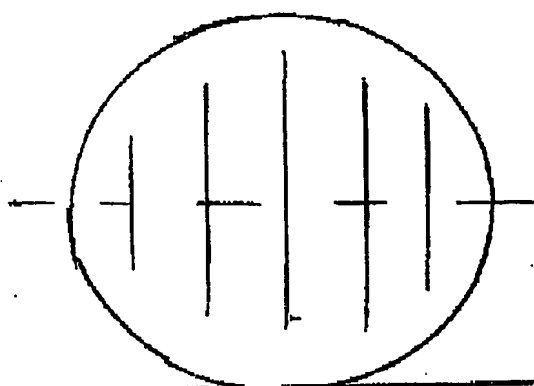
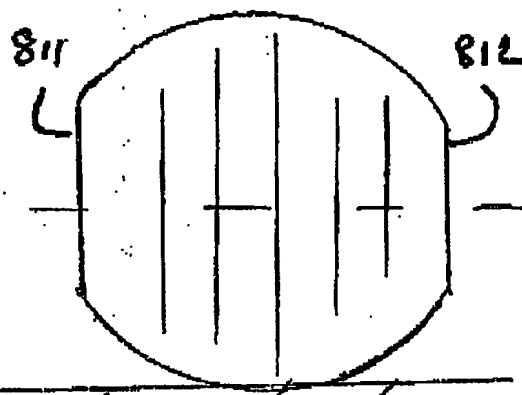
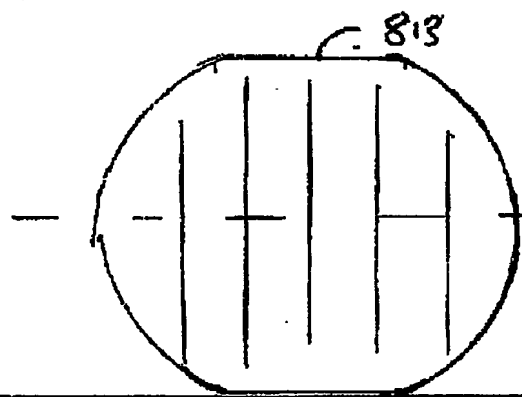
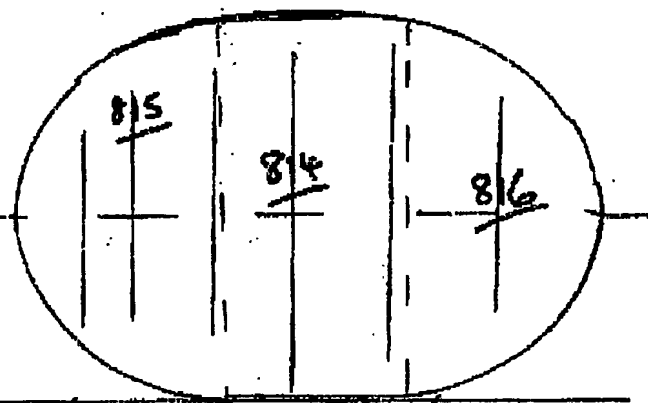
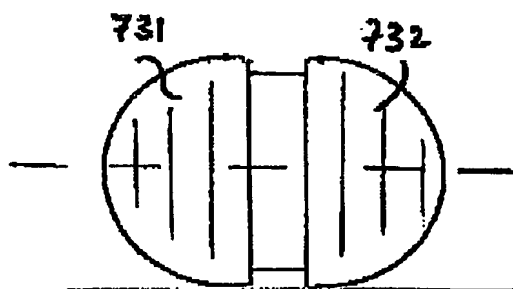
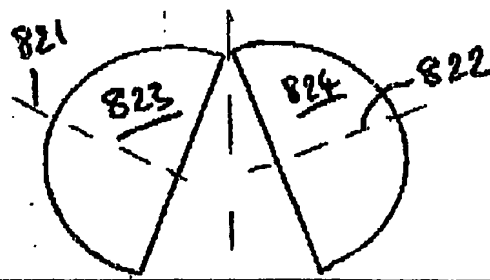
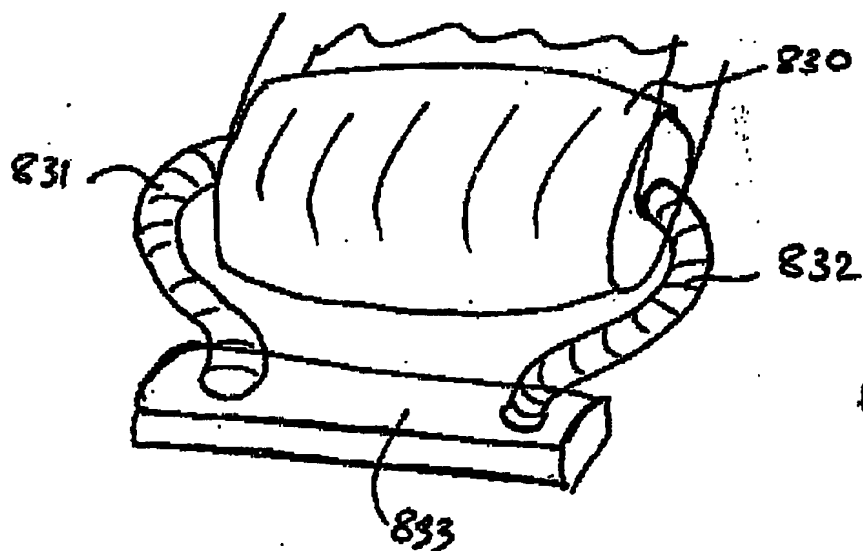
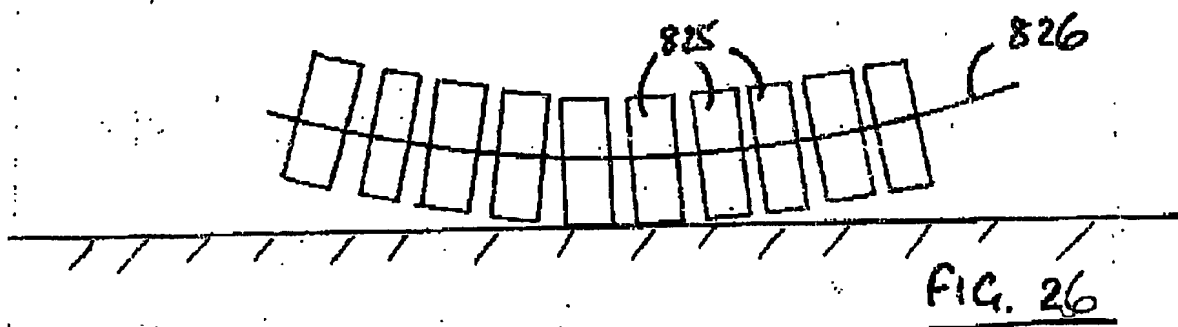
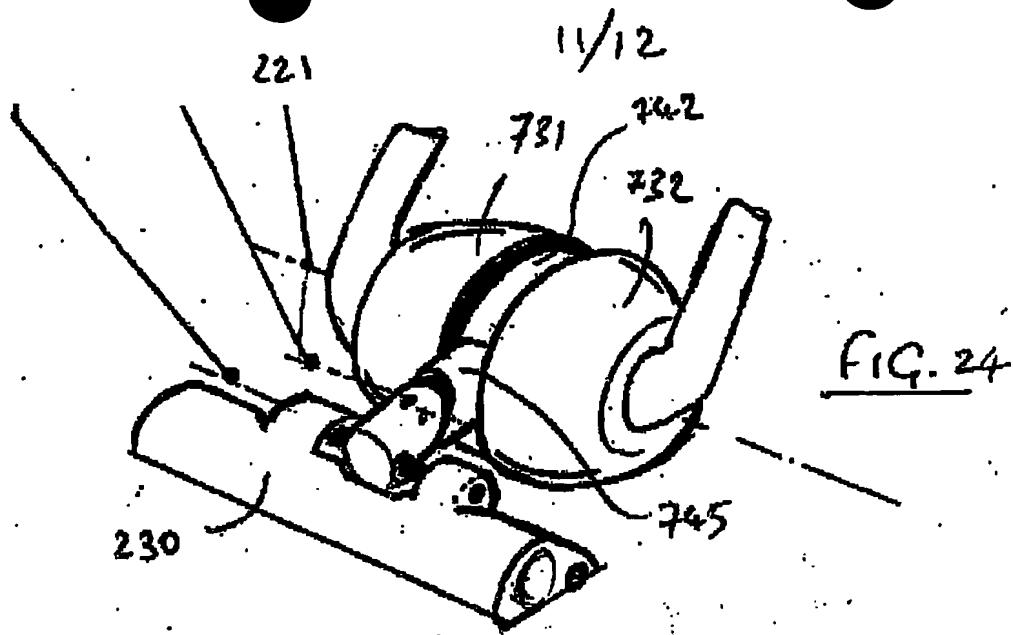


FIG. 23

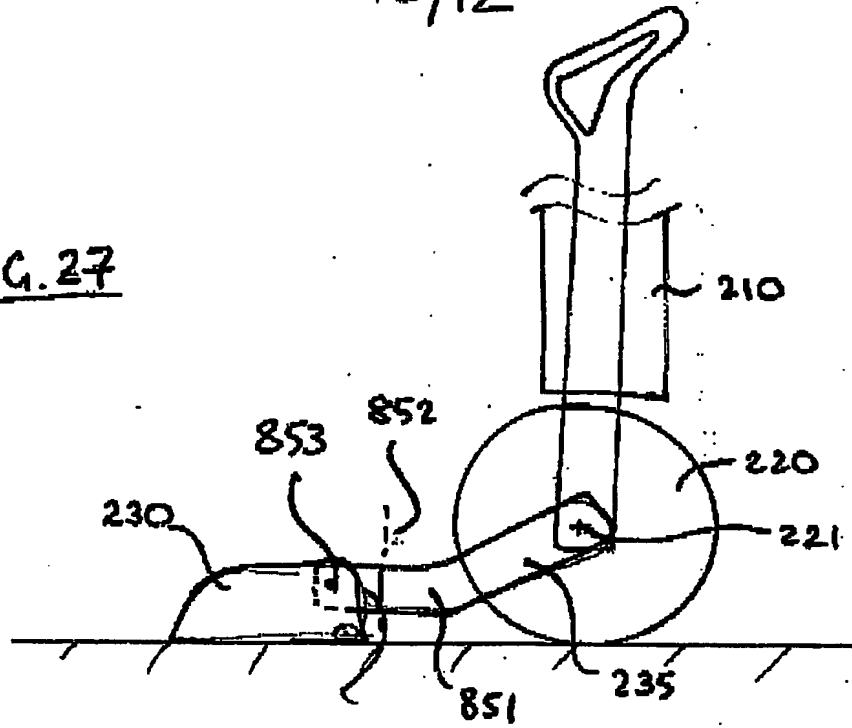
10/12

FIG. 18FIG. 19FIG. 20FIG. 21FIG. 22FIG. 25





12/12

FIG. 27

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